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JC863 U.S. PTO 06/20/00

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PTO/SB/05 (4/98)
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No.	1826-015
First Inventor or Application Identifier	Bernhard Kraus, et al
Title	Infrared Thermometer for Preforming Temperature . .
Express Mail Label No.	EL467160291US

JC863 U.S. PTO 09/598060 06/20/00

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. [✔] * Fee Transmittal Form *(e.g., PTO/SB/17)*
(Submit an original and a duplicate for fee processing)

2. [✔] Specification [Total Pages 10]
(preferred arrangement set forth below)
- Descriptive title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings *(if filed)*
- Detailed Description
- Claim(s)
- Abstract of the Disclosure

3. [✔] Drawing(s) *(35 U.S.C. 113)* [Total Sheets 1]

4. Oath or Declaration [Total Pages 2]
   a. [✔] Newly executed (original or copy)
   b. [ ] Copy from a prior application (37 C.F.R. § 1.63(d))
   (for continuation/divisional with Box 16 completed)
      i. [ ] DELETION OF INVENTOR(S)
      Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

NOTE FOR ITEMS 1 & 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

5. [ ] Microfiche Computer Program *(Appendix)*

6. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
   a. [ ] Computer Readable Copy
   b. [ ] Paper Copy (identical to computer copy)
   c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

7. [✔] Assignment Papers (cover sheet & document(s))
8. [ ] 37 C.F.R.§3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney
9. [✔] English Translation Document *(if applicable)*
10. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
11. [✔] Preliminary Amendment
12. [✔] Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)
13. [ ] * Small Entity Statement(s) *(PTO/SB/09-12)* [ ] Statement filed in prior application, Status still proper and desired
14. [ ] Certified Copy of Priority Document(s)
(if foreign priority is claimed)
15. [✔] Other: a check for $ 40 & $ 708

16. **If a CONTINUING APPLICATION,** *check appropriate box, and supply the requisite information below and in a preliminary amendment:*
[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No: _____/_____
Prior application information: Examiner _____ *Group / Art Unit:* _____
For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

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Signature		Date	June 20, 2000

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IN THE UNITED STATES PATENT & TRADEMARK OFFICE

Appln. Ser. No.:	Filed:	Inventor(s):	Atty Dkt:
Not Assigned		Kraus, Bernard et al.	1826-015

Title: **INFRARED THERMOMETER FOR PERFORMING TEMPERATURE MEASUREMENTS AT DIFFERENT SITES**

Examiner: Not Assigned	Art Unit:

Asst. Comm'r for Patents
Washington, D.C. 20231-0001

June 29, 2000

PRELIMINARY AMENDMENT

Dear Sir:

Prior to the initial Office Action, please amend the above-identified application as follows:

In the Claims

Please amend the following claims:

In claim 1, line 5 delete "characterized in that" insert therefor --wherein--.

In claim 2, line 4 delete "characterized in that" insert therefor --wherein--;

line 4, after "includes" insert "at least"; and

line 4, after "(2)" delete "and/".

In claim 3, line 3 delete "characterized in that" insert therefor --wherein at least--;

line 3, after "(5)" delete "and/"; and

line 4, after "is" delete "/are".

In claim 4, line 1 and 2 after "claim 1" delete ", 2 or 3"; and

line 4, delete "characterized in that" insert therefor --wherein--.

In claim 5, line 1 and 2 after "claim 1" delete "or 2"; and

line 3, delete "characterized in that" insert therefor --wherein--.

In claim 6, line 1 and 2 after "claim 1" delete "or 2";

line 3, delete "characterized in that" insert therefor --wherein--.

In claim 7, line 2 delete "characterized in that" insert therefor --wherein--.

In claim 8, line 2 delete "characterized in that" insert therefor --wherein--.

In claim 9, line 2 delete "characterized in that" insert therefor --wherein--.

In claim 10, line 5 delete "characterized in that" insert therefor --wherein--.

In claim 11, line 2 delete "characterized in that" insert therefor --wherein--.

In claim 12, line 1 and 2 after "claim 10" delete "or 11"; and

line 3, delete "characterized in that" insert therefor --wherein--.

Please add the following new claims:

--13. The infrared thermometer as claimed in claim 2, wherein at least the probe head (5) or the probe tip (2) is pivotal in at least one spatial plane.--

--14. The infrared thermometer as claimed in claim 2, wherein the infrared thermometer includes a first switch (3) actuatable when a probe head (5) is installed, and that the calculation of a temperature indication value from the temperature measurement values is influenced by actuation of said first switch (3).--

--15. The infrared thermometer as claimed in claim 3, wherein the infrared thermometer includes a first switch (3) actuatable when a probe head (5) is installed, and that the calculation of a temperature indication value from the temperature measurement values is influenced by actuation of said first switch (3).--

--16. The infrared thermometer as claimed in claim 2, wherein the infrared thermometer includes a second switch (4) actuatable when a protective cover (6) is installed over a probe tip (2), and that the calculation of a temperature indication value from the temperature measurement values is influenced by actuation of said second switch (4).--

--17. The infrared thermometer as claimed in claim 2, wherein probe head (5) includes and an opening for infrared radiation.--

--18. The infrared thermometer as claimed in claim 17, wherein the geometrical shape of the probe head (5) is selected so that the measurement site is shielded from infrared radiation emanating from the environment.--

--19. The infrared thermometer as claimed in claim 17, wherein the surface (8) of the probe head (5) located at the end remote from the measurement site during a temperature reading is of a funnel-shaped configuration.--

--20. The infrared thermometer as claimed in claim 17, wherein the opening of the probe head (5) is closed by a window (9) transparent to infrared radiation.--

--21. The method as claimed in claim 11, wherein at least one of the parameters (d3; d4) takes the non-linear influence of the body temperature on the skin temperature on the skin temperature into account.--

REMARKS

The amendment is filed prior to the receipt of the first Office Action in order to place the claims in better U.S. format.

A favorable consideration of the application as herein amended is respectfully solicited.

Respectfully submitted,

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Dated: 20 June 2000

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Infrared Thermometer for Performing Temperature Measurements at Different Sites

Infrared thermometers for determining body temperature have been in use for several years. Among the most widely known are infrared thermometers for measuring the temperature in a person's ear. Such an infrared thermometer is known from EP 0 388 463. It includes an infrared radiation sensor measuring the infrared radiation emitted by the measurement site, and an ambient temperature sensor measuring the temperature of the radiation sensor. The signals of both sensors are needed for determining the body temperature. Considering that the ear is readily accessible while at the same time affording reliable protection from external impact, accurate body temperature readings can be generally provided with this arrangement. However, in view of the temperature gradient in the ear canal, the measured temperature depends on how the thermometer is manipulated. This presents a problem particularly with small children where the probe of the thermometer does not fit into the ear canal because of the probe's relatively large diameter. Additional inaccuracies that may occur are attributable to the presence of cerumen in the ear canal or the use of contaminated protective covers.

Also commercially available are infrared thermometers which are suited to temperature measurement in the axilla or on the skin surface. Where body temperatures are taken in the axilla or on the forehead or in the temple region, measurement inaccuracies due to external impact are a frequent occurrence. Clinical tests have revealed that the differences to oral or rectal readings are greater here than the temperature measurement in the ear.

An infrared thermometer marketed under the designation „National DM-T2S" or „DM-T2A" includes several detachable probe heads possessing differing outside diameters. The thermometer therefore has only a radiation inlet opening and a device for attaching the probe heads, making it necessary to select the appropriate probe head prior to a temperature measurement.

It is an object of the present invention to provide an infrared radiation thermometer and a method permitting the body temperature to be determined from readings taken at different sites on a person's body.

The present invention relates to an infrared thermometer which is suited to body temperature measurements at different sites - including, for example, a person's ear, mouth, forehead, skin, temple, rectum or axilla. In contrast to contact thermometers for oral, rectal or axillary measurements, the infrared thermometer requires however that it be adapted to fit the particular measurement site. A measurement in the ear necessitates a probe head that is sized to fit the ear diameter. In addition, the use of protective covers is advantageous in this case.

For measurements on the skin surface, for example, on the forehead or on the temple, means are advantageously provided in order to minimize errors introduced by reflection of infrared radiation on the skin surface. One possibility involves shielding of the measurement site and back-reflection of infrared radiation by means of a suitably shaped mirror. However, the mirror may be dispensed with if the measurement site is shielded by the probe head such that the radiation component reflected by the skin emanates from the probe head itself, rather than from the environment. By means of the

known probe head temperature it is then possible to correct the measured radiation temperature correspondingly. During a measurement on the forehead or temple it is wise to scan a major area, meaning that the thermometer is moved across the skin surface, and to use the maximum temperature value measured during this manipulation for further calculation of the body temperature. A protective cover is not absolutely necessary for such measurements on the skin.

A thermometer of the present invention includes in a manner known in the art an infrared radiation sensor and an ambient temperature sensor. In the method of the present invention the body temperature T indicated by the thermometer is calculated in dependence upon the measured ambient temperature Ta which has a strong influence particularly on the skin temperature, the temperature Tb determined by radiation measurement in a manner known in the art from the signals of the ambient temperature sensor and the radiation sensor, and parameters determined during the prior calibration of the thermometer. To be able to compare the temperature readings taken at different locations on the body properly, the provision of an oral, rectal or core temperature equivalent by means of a corresponding calculation is appropriate. The body temperature T is calculated, for example, by applying the formula given below where d0, d1, d2, d3 and d4 are the parameters identified. This formula enables, for example, also the radiation component reflected by the skin to be taken into account. The non-linear influence of the body temperature on the skin temperature or the temperature in the ear canal can be taken into account by the parameters d3 and d4. This is advantageous because for a patient running a high temperature the then improved blood flow makes the surface temperature of the body less strongly dependent on

the ambient temperature than for a person running no temperature:

$$T = Tb + d0 + d1(Tb-Ta) + d2(Tb-Ta)^2 + d3(Tb-Ta)(d4-Tb)$$

A first embodiment of an infrared thermometer of the present invention is illustrated schematically in FIG. 1. The Figure depicts a thermometer 1 having a probe tip 2 configured to perform a measurement in the ear and adapted to have affixed to it a probe head 5 suitably shaped for taking readings on a person's forehead. To do this, a first switch 3 is actuated which causes the temperature calculation method and some parameters to be switched from the ear to the forehead mode. Still further, the duration of measurement is increased from, for example, one second to five seconds giving the user sufficient time to move the thermometer across the forehead/temple. Advantageously, the thermometer indicates the maximum temperature measured.

Optionally, it is possible to attach to the probe tip 2 of the infrared thermometer 1 a protective cover 6 for performing measurements in the ear, the probe head 5 for measurements on the forehead, or to attach first the protective cover 6 and install the probe head 5 over the cover. A second switch 4 detects the presence or absence of a protective cover 6. The measurement method and the parameters used for evaluation are suitably selected by the first and second switch. It is also possible to substitute a single two-stage switch for two switches.

In a second embodiment of an infrared thermometer of the present invention, the thermometer is equipped with a radiation inlet opening and a fastening device in a manner known in the art. Suitable for attachment to the fastening device

are not only a probe tip for taking temperature readings in the ear canal but also a probe head 5 for taking temperature readings on comparatively large skin surfaces.

In both embodiments the probe head 5 has an opening enabling infrared radiation to travel from the measurement site to the radiation inlet opening of the thermometer. To avoid contamination of the radiation inlet opening, the opening of the probe head 5 can be closed by a window 9 transparent to infrared radiation. The surface 8 of the probe head 5 for taking temperature readings on a person's forehead is preferably of a funnel-shaped configuration at the end remote from the measurement site to avoid corruption of the measurement result by infrared radiation emanating from the environment, which is reflected from the skin into the thermometer.

The thermometer herein described has the following particularly advantageous properties:

- The thermometer is suited to perform body temperature measurements at different sites, for example, in the ear, on the forehead or on the temple.

- The probe tips or probe heads are optimally adapted to the different measurement sites.

- Exchanging the probe tip or probe head automatically involves switching of the parameters for the method for calculating the body temperature.

To obtain accurate skin temperature readings it is important to make sure, also during scanning across the skin, that no radiation can be reflected from the environment into the thermometer. In addition, the measurement spot sensed by the thermometer has to be as small as possible and be of a

constant size to achieve a good and uniform local temperature resolution. It is therefore necessary for the relative distance of the thermometer to the skin and for the angle between skin and thermometer to be maintained constant during the measurement. Both requirements can be satisfied by a movable probe head which invariably engages the skin during the measurement. As the thermometer is moved, the probe head 5 follows the contour of the skin surface, even when the angle between the thermometer 1 and the skin surface varies.

FIG. 2 shows such a thermometer schematically. The probe head 5 is connected with the probe tip 2 of the infrared thermometer 1 via a joint 7. The infrared sensor in the infrared thermometer senses a small measurement spot on the skin. The infrared radiation is passed through suitable optics (infrared fiber, metal tube, mirror, lenses) to the sensor. The hemispherical probe head 5 prevents the ingress of infrared radiation from the environment, maintaining at the same time a constant distance between sensor and skin. By detaching the movable probe head 5 (and substituting another probe head, if applicable) the skin thermometer can be converted into an ear thermometer.

In an embodiment of an infrared thermometer of the present invention, not shown in the Figures, the probe tip 2 is pivotally secured to the infrared thermometer.

Patent Claims:

1. An infrared thermometer having an infrared sensor and a probe tip including a radiation inlet opening enabling infrared radiation to travel from a measurement site to the infrared sensor,
characterized in that it includes additionally a probe head (5) mountable on the probe tip (2).

2. An infrared thermometer having an infrared sensor and a radiation inlet opening enabling infrared radiation to travel from a measurement site to the infrared sensor,
characterized in that it includes a probe tip (2) and/or a probe head (5) demountably attachable to the thermometer (1).

3. The infrared thermometer as claimed in claim 1 or 2,
characterized in that the probe head (5) and/or the probe tip (2) is/are pivotal in at least one spatial plane.

4. The infrared thermometer as claimed in claim 1, 2 or 3,
characterized in that the infrared thermometer includes a first switch (3) actuatable when a probe head (5) is installed, and that the calculation of a temperature indication value from the temperature measurement values is influenced by actuation of said first switch (3).

5. The infrared thermometer as claimed in claim 1 or 2,
characterized in that the infrared thermometer includes a second switch (4) actuatable when a protective cover (6) is installed over the probe tip (2), and that the calculation of a temperature indication value from the temperature

measurement values is influenced by actuation of said second switch (4).

6. The infrared thermometer as claimed in claim 1 or 2,
characterized in that the probe head (5) includes an opening for infrared radiation.

7. The infrared thermometer as claimed in claim 6,
characterized in that the geometrical shape of the probe head (5) is selected so that the measurement site is shielded from infrared radiation emanating from the environment.

8. The infrared thermometer as claimed in claim 7,
characterized in that the surface (8) of the probe head (5) located at the end remote from the measurement site during a temperature reading is of a funnel-shaped configuration.

9. The infrared thermometer as claimed in claim 6,
characterized in that the opening of the probe head (5) is closed by a window (9) transparent to infrared radiation.

10. A method of determining a body temperature (T) from at least one parameter (d0; d1; d2; d3; d4), a skin temperature (Tb) determined by radiation measurement, and an ambient temperature (Ta),
characterized in that the body temperature is calculated applying the following formula:

$$T = Tb + d0 + d1(Tb-Ta) + d2(Tb-Ta)^2 + d3(Tb-Ta)(d4-Tb)$$

11. The method as claimed in claim 10,
characterized in that the radiation measurement is performed with an infrared thermometer, and that the parameters (d0;

d1; d2; d3; d4) are determined during calibration of the infrared thermometer.

12. The method as claimed in claim 10 or 11, **characterized in that** at least one of the parameters (d3; d4) takes the non-linear influence of the body temperature on the skin temperature into account.

Abstract of the Disclosure

The invention is directed to an infrared thermometer and a temperature calculation method suitable for determining the body temperature at different measurement sites, for example, on a person's forehead or in the ear.

The thermometer includes a device for attaching a demountable probe head. Provision is made for different probe heads that are adapted to fit the different measurement sites.

(FIG. 1)

25 May 00/BH.

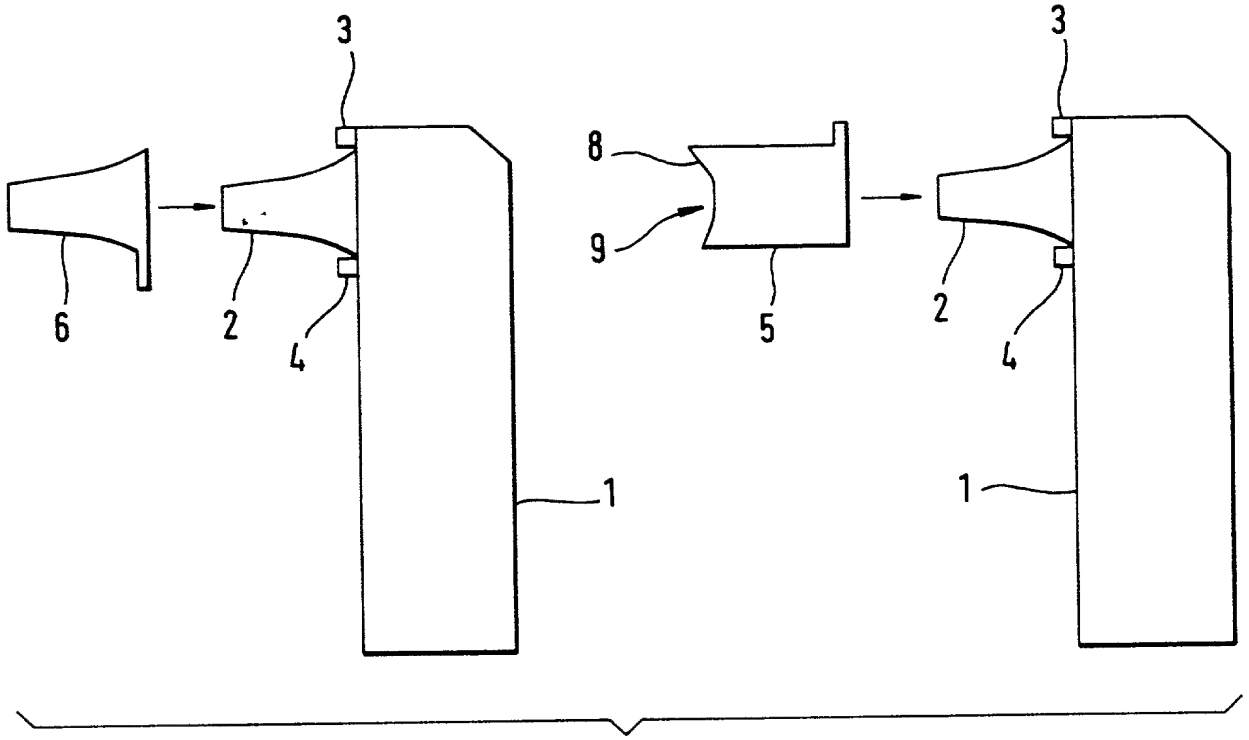
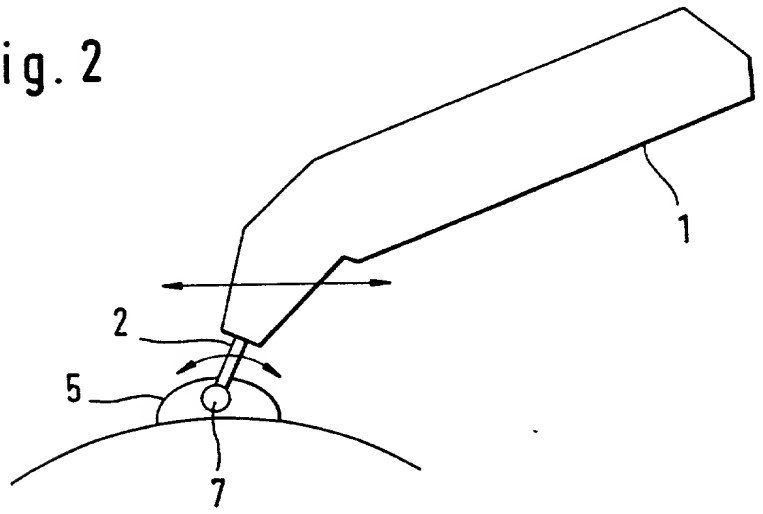


Fig. 1

Fig. 2



DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence or post office address, and citizenship, are as stated below next to my name and signature.

I believe I am an original, first, and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention **INFRARED THERMOMETER FOR PERFORMING TEMPERATURE MEASUREMENTS AT DIFFERENT SITES**, the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim the benefit under Title 35, United States Code, § 119, § 120, § 121, and/or § 365 of any United States application(s) and/or foreign/international applications listed below, and insofar as the subject matter or each of the claims of this application is not disclosed in the prior United States application(s) in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Serial Number	Filing Date	Status	Country/Type
199 29 503.4	June 28, 1999	pending	Germany

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorneys to prosecute this application and transact all business in the U.S. Patent and Trademark Office connected therewith, Hopgood, Calimafde, Kalil & Judlowe, LLP, a firm comprising

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Eugene J. Kalil, Reg. No. 16,686; Marvin N. Gordon, Reg. No. 23,094; Stephen B. Judlowe, Reg. No. 21,049; Francis J. Murphy, Reg. No. 24,537; Dennis J. Mondolino, Reg. No. 27,148; William G. Todd, Reg. No. 28,480; Ira B. Winkler, Reg. No. 29,223; James M. Bollinger, Reg. No. 32,555; Porter F. Fleming, Reg. No. 31,759; and Brian P. Murphy, Reg. No. 34,986; and associated therewith Bradley N. Ruben, Reg. No. 32,058.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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